

## Development of BEARS in 1997

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BEARS is a new initiative to develop a limited, light-mass, radioactive beam capability through the coupling of the LBNL Medical Cyclotron in Bldg. 56 to the 88" Cyclotron. This concept is described in the previous report entitled "BEARS: Radioactive Ion Beams at LBNL." This report describes the ongoing technological development and testing of some of the parts of the BEARS system, in particular the novel approach of coupling gas-jet transport to an ECR ion-source.

For these tests, the 88" cyclotron is being used to mimic the Medical Cyclotron, producing up to 10  $\mu$ A of 10 MeV protons. These beams are directed into the target chamber of our gas-jet transport system. We are currently producing  $^{11}\text{C}$  and  $^{14}\text{O}$  via (p,n) and (p, $\alpha$ ) reactions on the nitrogen component of the carrier gas but also intend to try a set of thin boron-nitride solid targets.

As the ECR (Electron Cyclotron Resonance) ion source requires very low pressures to operate, while the gas-jet system involves a pressure of one or two atmospheres, a highly effective gas-skimming system is required. We have constructed such a system, coupled directly to the ECR, with four differentially-pumped skimming stages (see Fig. 1). Tests have shown that the gas pressure is sufficiently reduced such that, with a full gas load, ECR performance is not significantly degraded.

In a gas-jet capillary transport system, the radioactive isotopes are carried along on aerosol particles (we are using ethylene glycol) suspended in the carrier gas. The heavy aerosol clusters leave the capillary exit in a narrow cone, allowing them to pass through the multiple gas-skimming stages (see Fig. 1). The opening angle of the diverging aerosol cone is sensitive to particle size and gas-jet conditions. We have been conducting tests to attempt to minimize this angle and hope to improve the skimming system efficiency as a result. The current best efficiency is about 20%.

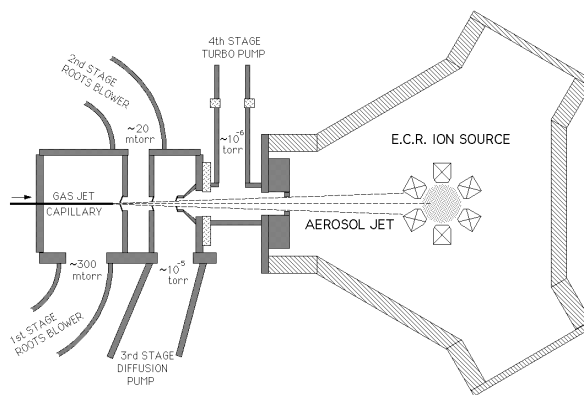


Fig. 1. Skimming System

Initial tests involving the injection of  $^{11}\text{C}$  and  $^{14}\text{O}$  into the ECR were conducted in the latter part of 1997. These tests were performed before the installation, within the ECR, of heated surfaces intended to catch and vaporize the aerosol clusters. In addition, there was little opportunity to optimize the various components of the system. Nevertheless, a beam of  $^{11}\text{C}$  was successfully extracted and detected, although at very low intensities. Systematic developments in 1998 should vastly increase efficiencies at all stages of the BEARS system, leading to significant intensities of  $^{11}\text{C}$  and  $^{14}\text{O}$  beams.

### Footnotes and References

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